UNITED STATES ARMY RESEARCH LABORATORY (ARL)
MICRO AUTONOMOUS SYSTEMS AND TECHNOLOGY (MAST)
COLLABORATIVE TECHNOLOGY ALLIANCE (CTA)
FINAL PROGRAM ANNOUNCEMENT (PA)
W911NF-06-R-0006
1 September 2006

SPECIAL REQUEST: Evaluation of the proposals submitted under this PA is a significant effort on the part of the Government. To that end, the Government is working to ensure that adequate time and resources are available for complete and thorough evaluation of all proposals submitted under this PA. **The Government therefore asks all offerors who intend to submit a proposal to be a Principal Member under this PA to inform the Government of their intention to do so by sending an email indicating such to Ms. Linda Young at linda.louise.young@us.army.mil by 25 September 2006.** Please do not send this email unless your organization is committed to submitting a proposal to be a Principal Member. Offerors are not required to send the email in order to submit a proposal; however this information will be extremely beneficial to the Government, and subsequently to the offerors, during the proposal evaluation process. This information will be kept closehold in the Government and will only be used to prepare for the proposal evaluation process. Thank you for your time and cooperation with this request. Any questions on this request can be addressed to Ms. Linda Young at linda.louise.young@us.army.mil. All other questions concerning the MAST CTA should be submitted to the website www.arl.army.mil/MASTCTA.

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PART I
EXECUTIVE SUMMARY

Purpose: The purpose of this United States Army Research Laboratory (ARL) **Micro Autonomous Systems and Technology (MAST) Collaborative Technology Alliance (CTA) Program Announcement (PA)** is to solicit offers that will help fulfill the research and development goals of the U.S. Department of the Army. The Army envisions the Alliance will bring together government, industrial and academic institutions to address research and development to enable the deployment of microsystems for tactical operations.

The objective of the Alliance is to perform enabling research and transition technology to enhance tactical situational awareness in urban and complex terrain by enabling the autonomous operation of a collaborative ensemble of multifunctional, mobile microsystems. To achieve this objective the Alliance is expected to advance fundamental science and technology in several key areas including small-scale aeromechanics and ambulation; propulsion; sensing, processing, and communications; navigation and control; microdevices and integration; platform packaging; and systems architectures. The PA notes though that the key to deploying microsystem technology is to consider the interplay between individual technologies. Responses to the PA should consider crosscutting themes carefully. Radical design and engineering methodologies are envisioned in which system-level performance is emphasized over the optimization of individual functions. To address these issues the PA identifies four Principal Members to lead three research centers and an integration effort.

Program Components: This CTA consists of two components: (1) the Fundamental Research Component; and (2) the Technology Transition Component. The Fundamental Research Component will provide for research, the results of which will be in the public domain. A fundamental research program is sought in four research areas. The first three research areas are focused on ***Microsystems Mechanics***, ***Processing for Autonomous Operation***, and ***Microelectronics***. These research areas will be conducted in academic institutions hereinafter referred to as Centers. The fourth research area, ***Integration,*** is focused on system analysis, modeling and experimentation research, and other integration issues and is expected, but not required, to be conducted by an industrial concern. The performance of collaborative (involving government, industrial and academic concerns) research is expected to result in integrated results and solutions in MAST. The Technology Transition Component will provide for the application of the fundamental research results to military and other Government applications.

Award Instruments: This PA will result in the award of two instruments: (1) a cooperative agreement as defined at 31 U.S.C. 6305 for the execution of the Fundamental Research Component; and (2) a procurement contract as defined in 31 U.S.C. 6303 for the execution of the Technology Transition Component. The cooperative agreement for the Fundamental Research Component will be awarded to a Consortium consisting of four Principal Members coinciding with the four research areas set forth above. This Consortium may also include General Members as necessary and appropriate to fulfill the goals of the MAST CTA Program. The Principal Member for ***Integration*** is expected (but not required to be) an industrial concern, and will also be considered the ***Lead*** of the Consortium. The Principal Members associated with the research Centers for ***Microsystems Mechanics***, ***Processing for Autonomous Operation*** and

Microelectronics must be academic concerns. The procurement contract will be awarded to the Lead of the Consortium. Individual tasks will be issued under the procurement contract as transition opportunities are identified from the research results under the cooperative agreement. **Under this PA, proposals are sought to select the four Principal Members for the MAST CTA. Proposals must address only one of the four research areas described above.** Should an offeror desire to propose under more than one of the research areas, a complete separate proposal must be submitted for each area.

Articles of Collaboration: In order to be considered for award as a Principal Member in response to this PA, offerors must agree to abide by the Articles of Collaboration (AOC) included with this PA. The AOC delineates the terms and conditions under which Consortium Members (both Principal Members and those General Members included in the proposals for the Principal Members selected for award) will work together under the Cooperative Agreement. **Proposals received that take exception to the AOC will not be considered for award under the MAST CTA**.

Period of Performance: Awards made as a result of this PA will provide for a period of performance of five years, with an optional five-year extension period.

Place of Performance: Performance by the Principal Member for Integration is limited to the US to facilitate technology transition. Other Principal Members, and all General Members and Subawardees, may be located and perform at any location. For example, a Principal Member (a Center) may be located and perform outside the US.

Funding: This PA is issued subject to the availability of funds. **PART III** of the PA provides the estimated funding levels for the four research areas of the Fundamental Research Component under the cooperative agreement. Funding for the research effort falls under the "6.1" category, which is defined in **PART III**. ARL has submitted the requisite documents to request funding for the period covered by the cooperative agreement; however, offerors are reminded that this request is subject to Presidential, Congressional and Departmental approval. **The funding levels provided in the PA are for proposal preparation purposes only. The actual funding level of the cooperative agreement will be updated annually as part of the appropriation process**. No funding is currently designated for the Technology Transition Component. Funding for the Technology Transition Component under the procurement contract is expected to be received from Government organizations as opportunities for transition of technology from the Fundamental Research Component are identified for specific military applications.

Profit/Fee: Profit/fee is not permitted under the cooperative agreement for the Fundamental Research Component. Profit/fee will be permitted under the Technology Transition Component for the specific transition tasks executed under the procurement contract. The rate of profit/fee will be negotiated on a task-by-task basis, in accordance with DFARS 215.404-4, based on the technical and performance risk associated with the specific task being executed.

Cost Sharing: Cost sharing is not required to be responsive to the PA, that is, no level of cost sharing is stipulated; however, it is encouraged. During the evaluation of proposals, cost sharing will be evaluated as it relates to the evaluation factors listed in the PA, based on the degree to

which the proposed cost sharing enhances the proposal to result in added benefits to the MAST CTA Program. In order for the proposed cost sharing to receive appropriate credit during the evaluation process, the proposal should evidence **a firm commitment** to provide such cost share and also evidence **a process for integrating the cost share into the collaborative research program**.

Proposal Submission: PART VIII of the PA provides information on proposal preparation and submission. Offerors should note that there are page limitations and other requirements associated with the submission process. Proposals in connection with this PA are due by the date and time specified in **PART VIII**.

Evaluation and Award: Evaluation and Award in connection with this PA will be performed in accordance with **PART IX**.

Questions & Comments: All questions or comments concerning this PA will be posted through the MAST CTA website at www.arl.army.mil/MASTCTA. Questions and comments should be concise and to the point. In addition, the relevant part and paragraph of the PA should be referenced. Responses to questions received will be posted to the MAST CTA website for the benefit of all interested parties. Should an offeror have questions they believe are of a proprietary nature, the offeror must clearly state so in the question when posed. Answers to questions of a proprietary nature will be provided via email directly to the poser of the question.

Opportunity Conference: An Opportunity Conference concerning the MAST CTA is scheduled for 15 August 2006. The purpose of the Opportunity Conference is to provide potential offerors with information concerning the MAST CTA Program and to provide an opportunity for potential offerors to discuss the MAST CTA Program with Government personnel. Details concerning registration and logistics associated with the Opportunity Conference are located on the MAST CTA website. All presentations, questions, and answers discussed at the Opportunity Conference will be posted subsequently on the MAST CTA website.

Business Point of Contact (POC): The following is the business POC for the MAST CTA. As a reminder, all questions and comments concerning the MAST CTA are to be submitted under the MAST CTA website identified above, and are not to be directed to the POC listed below.

Linda L. Young
919.549.4355

Award Schedule: The following is an estimated schedule for the events leading to award under this PA:

EVENT	**ESTIMATED DATE/TIMEFRAME**
Draft PA released	16 July 2006
Opportunity Conference	15 August 2006
Final PA released	1 September 2006
Proposals due	25 October 2006
Evaluation and Negotiations	November 2006-February 2007

Final Proposals due	February 2007
Award	May 2007

PART II
PROGRAM BACKGROUND

New realities demand innovative concepts to focus the talent of industry and academia on critical technology needs of the Army. Ten years ago the ARL responded to the challenge by changing the way it did business. The new strategy focused in-house laboratory research on Army-specific business areas while establishing extramural centers of research in areas where state-of-the-art expertise could be leveraged to satisfy Army technology needs. The combination of government in-house, industry, and academic components striving together for excellence created a new paradigm for Army research -- a "federated laboratory". The FedLab concept proved to be an overwhelming success, a “win-win” situation for all concerned – ARL, the private sector consortia members, and the Army system developers. It was awarded the Hammer Award for Reinventing Government by former Vice President Al Gore.

The CTA Program is the follow-on to the FedLab Program and, on 31 May 2001, and as a result of a competitive process, ARL established five CTAs in the areas of Advanced Sensors, Power & Energy, Advanced Decision Architectures, Communications & Networks, and Robotics. The proposed MAST CTA is modeled after these CTAs and continues the paradigm of collaborative work involving government, industry, and academia. The projected scope of the MAST CTA Fundamental Research Component is approximately $50 million over the first five years and $50 million for a five-year option. ARL’s strategy is to continue exploiting technology and expertise where it exists through the issuance of the awards resulting from this PA. This PA seeks to select an industrial and academic consortium that will work with ARL scientists and engineers to help fulfill critical military modernization objectives.

ARL and the Consortium selected for award, will establish one collaborative research Alliance to address issues concerning MAST including microsystems mechanics, processing for autonomous operation, microelectronics, and integration. The objective of the Alliance is to enhance tactical situational awareness in urban and complex terrain by enabling the autonomous and semi-autonomous operation of a collaborative ensemble of multifunctional, mobile microsystems.

Additionally, other Government agencies will be invited to join this Alliance and to contribute, as appropriate, their technical expertise and personnel, and to participate in the MAST CTA. This intellectual synergy will include sharing equipment and facilities to promote efficiency. A significant goal of this effort will be to create a critical mass of private sector and Government scientists and engineers focused on solving the military technology challenges in the autonomous operation of multiple ground and air miniature platforms as well as supporting and stimulating dual-use applications of this research and technology to benefit commercial use. To achieve this, the Alliance is expected to produce advances in fundamental science and technology, demonstrate and transition technology, and develop research demonstrators for warfighter experimentation.

PART III
FUNDAMENTAL RESEARCH COMPONENT

Introduction

The Fundamental Research Component will be funded under the 6.1 (basic research) budget category. The research proposed is expected to comply with the appropriate funding definition, from the DFAS-IN Manual 37-100-06, as follows:

> Budget Activity 6.1 - Basic Research: Basic Research efforts provide fundamental knowledge for the solution of identified military problems. Includes all effort of scientific study and experimentation directed toward increasing knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs. It provides farsighted, high payoff research, including critical enabling technologies that provide the basis for technological progress. It forms a part of the base for (a) subsequent exploratory and advanced developments in Defense-related technologies, and (b) new and improved military functional capabilities in areas such as communications, detection, tracking, surveillance, propulsion, mobility, guidance and control, navigation, energy conversion, materials and structures, and personnel support.

It is the responsibility of the offerors to suggest how they would optimize the use of the available funds in order to further the MAST CTA objectives. It is the intent of this PA to solicit the most creative, innovative and flexible approaches to the ultimate goal of generating and exploiting technology to solve pressing military and commercial sector problems. Therefore, while important research issues have been suggested below, offerors may propose to alter the suggested content to further the MAST CTA goals. An offeror may propose to investigate additional research issues, or to deemphasize research issues suggested in this PA. However, offerors are not to alter or propose additional research areas or Centers. All results of the Fundamental Research Component must be publishable without constraint in the public domain.

ARL acknowledges that the focus of the Fundamental Research Component may change during the period of performance. Therefore, ARL reserves the right to withhold up to 10% of annual Alliance funding provided to ARL through the appropriation process to fund novel research projects related to the Fundamental Research Component. These novel research projects are expected to be funded under the MAST CTA cooperative agreement, and these projects may be proposed and performed by Consortium members, as well as entities not currently members of the Consortium.

Definition, Scope, and Rationale

Operations Enduring Freedom and Iraqi Freedom have demonstrated the value of robotic platforms, both aerial and ground, that are teleoperated remotely. Robotic platforms extend the warfighter's senses and reach and have been used as sensor, communications, and, in some instances, weapons platforms. Especially in complex terrain, like caves and mountains, or an urban environment, these platforms provide operational capabilities to the warfighter that would otherwise be costly, impossible, or deadly to achieve.

Future enhancements to warfighting capabilities require a reduction in platform size and the cohesive operation of multiple platforms. A reduction in the size of the platform increases capabilities by allowing warfighters to carry multiple platforms. However, teleoperation of multiple platforms by a single operator increases the burden on the operator without necessarily improving operational effectiveness. For that reason, it is necessary for the platforms to operate autonomously to some extent.

The objective of the Alliance is to enhance tactical situational awareness in urban and complex terrain by enabling the autonomous operation of a collaborative ensemble of multifunctional, mobile microsystems. The length-scale of the microsystems is approximately 30 cm or less and the platforms are lightweight, ca. 500 g or less. To achieve this objective the Alliance is expected to produce advances in fundamental science and technology, demonstrate and transition technology, and develop research demonstrators for warfighter experimentation.

Some degree of mobility is critical to the operational effectiveness of the collection of platforms. This includes, but is not limited to, flying, crawling, walking, and jumping. Consider, for example, a small unit searching a building for potential human threats. The platforms are emplaced or launched initially by the unit but their movement is guided by perceived improvements in situational awareness provided by modifying the platform distribution. Thus, determining waypoints, as well as stable controlled movement between waypoints is critical. The ability to hover or perch is also advantageous to operations. Through their movement the platforms develop a map of the building interior which is transmitted to the operational (human) unit. The map may indicate the location of potential threats and it may also be annotated by imagery.

Similar capabilities are also required when searching caves or demolished buildings, but the terrain is more complex to map and to navigate. Paths are irregular and ground surfaces are no longer smooth. Air flow may be gusty. In caves, especially, the lack of ambient lighting and the thermal uniformity of the environment complicate navigation.

Surveillance of a wide area for perimeter or asset defense is an alternative scenario that requires full autonomy from a collection of microsystems. Not only must the collection provide situational awareness, it must also respond in some manner (lethally or non-lethally) prior to human intervention. Thus, the requirements on processing to understand and respond appropriately are increased over those of the small unit search.

Enabling the capabilities reflected in the three search and surveillance scenarios above requires the solution of fundamental technical issues in several key areas including: aeromechanics and ambulation; electrical power and propulsion; sensing, processing, and communications; navigation and control; mobile, distributed sentience; microdevices and heterogeneous integration of materials; platform packaging; and systems architectures. However, the impact and interplay between conflicting requirements on these technical issues are so complex that investigating a single issue in isolation of the others will not generate an efficient and operationally effective ensemble of microsystems.

To appreciate system constraints most fully one should consider the problem as providing mobility to a sensor network as opposed to miniaturizing an unmanned system. Solutions to processing,

communications, and mobility, for example, that are satisfactory for large systems do not scale when platforms are reduced to the size considered in this CTA. For example, platform size and weight limit the power available over the duration of a mission. The largest percentage of available power is utilized for mobility. The limited power in turn constrains the bandwidth of intra-platform communications, e.g., between sensors and processors, processors and transmitters, as well the bandwidth of inter-platform communications, and limited communications impact the ability of the microsystem collective to sense, understand, and respond coherently as a group.

Further, the interfaces, both physical and metaphorical, between components become more significant as one attempts to integrate functionality and reduce scale. In one respect a thin physical interface between two components is more desirable than a cable or a wire. But insuring the continuity of physical parameters across small junctions, small apertures, or other boundaries becomes difficult. If designed poorly, the interface can result in unacceptable losses that negate the advantages of integration.

One must also be cognizant of the fact that the attraction of small, integrated systems belies the existence of a large infrastructure to maintain it. The reliance upon cell towers and a local power grid is not apparent when one uses a cell phone. But without the towers and power grid, it is not possible to establish a telephone circuit or recharge portable devices. Similar issues related to infrastructure are certain to arise when creating a network of microsystems. The dependence of a collection of microsystems on macro-infrastructure should be considered.

This PA identifies three Centers for research and an integration effort, led by four Principal Members; however the key to developing microsystem technology is to consider the interplay between all of these. Responses to the PA should consider carefully this interplay. Radical design and engineering methodologies are envisioned in which system-level performance, maneuvering, and functional adaptability are emphasized over the optimization of individual functions. Particularly exciting multidisciplinary themes that could potentially represent breakthrough technologies for microsystem applications include:

1. Bio-inspired or bio-mimetic materials and devices for mobility, navigation, and control
2. Active materials with embedded sensors for mobility, navigation, and control
3. Multifunctional materials and structures, for example, to provide structural integrity and mission functionality
4. Computational sensing to reduce power required to process data into information

The following represents a discussion of the three research Centers and the effort associated with Integration. It is important for offerors to note that proposals will be evaluated based upon their vision in an area and a measured approach to achieving this vision in the near-, mid-, and far-term. The example research topics presented below are meant to be representative and not exhaustive. It is not necessary for offerors to address all or even any of these topics. Instead, offerors should consider the increasingly complex capabilities required in each of the scenarios described above and address the technological hurdles they feel need to be overcome. Offerors should convey a depth of understanding by addressing how these hurdles can be overcome in the near-, mid-, and far-term.

Center on Microsystem Mechanics

Research in this technical focus area will develop a fundamental understanding of mechanics for small unmanned air and ground vehicles as needed to obtain desired mobility objectives. These objectives span across the disciplines of aeromechanics, ambulation, and propulsion; with the aeromechanics discipline focused on key elements of microsystem flight, the ambulation discipline focused on key elements of microsystem ground movement, and the propulsion discipline focused on the overall process of taking energy from a fuel source and converting it into useful mechanical motion. The research pursued in these disciplines should build the foundations of new microsystem technologies that expand maneuvering capabilities at the extremes of the anticipated operational environment. This includes maneuvering in both confined environments such as building interiors, tunnels, and caves, and unconfined environments such as a battle zone perimeter defense. The need to maneuver over obstacles, through rough terrain, and within gusty wind conditions are important considerations for this research as shall be discussed further in this section.

One technical issue of importance to platforms of this size class is stability and control in a large-disturbance environment. Thus, for example, a small unmanned aerial vehicle can be expected to encounter atmospheric gust disturbances whose length and velocity scales are of the same order of magnitude than those of the vehicle itself. Small unmanned ground vehicles can also be expected to negotiate obstacles whose size is a considerable fraction of that of the vehicle itself, without tipping over. These situations can be exacerbated because the disturbance input is often at frequencies comparable to that of the platforms own natural frequency. Traditional linear vehicle stability and control approaches may be insufficient for this application owing to the inherent nonlinear mechanics dominating the vehicle response. An attractive approach for vehicle maneuverability is the use of bio-inspired or biomimetic legs and wings, as nature has provided these examples of successful solutions to micro-scale systems operating in a large disturbance environment.

With respect to aeromechanics, flapping wing flight motivated by invertebrates and small birds appears more energy-efficient and gust-tolerant at these sizes than conventional fixed and rotary wing designs. The understanding of the aerodynamics of the clap and fling mechanism that characterizes flapping wing flight is not adequately understood because no analytical theory of unsteady, low Reynolds number vortex-dominated aerodynamics is currently available. The aeroelastic wing response needs to involve the efficient coupling between massive flow separation and highly-flexible structures. In addition, the role of wing deformation in invertebrate flight control is not well understood.

Research associated with small-scale rotary-wing and other more traditional forms of flight is required for a complete understanding of microsystem aeromechanics. Such research should emphasize the application of fundamental laws of fluid mechanics to define a role for this approach that satisfies anticipated constraints on propulsion and weight. Energy-based performance comparisons between traditional and flapping-wing flight mechanics may be extremely useful in guiding the emphasis and focus of future research in aeromechanics.

With respect to ambulation, small walking ground vehicles have already demonstrated the ability to traverse relatively large obstacles. Further study is required to characterize and improve the

performance of biomimetic leg systems with respect to various surfaces and terrains. For a particular terrain, new and unique ambulation concepts should be optimized for weight, economy, and speed. There is a need to develop a fundamental understanding of the influence that key design parameters, such as material stiffness, joint size/location, structural weight, and characteristic lengths, have on ambulation performance. Improved analytical capabilities that combine formulations of multibody dynamics, elasticity, and contact constraints are required to perform accurate studies and assessments of advanced ambulation concepts.

Furthermore, ambulation via biomimetic appendages cannot be considered independent of the actuation system. While qualitative studies have been performed, more rigorous efforts that quantify the capability of various actuation approaches to mimic natural muscle with respect to strain, density, efficiency, speed, damping, and stiffness would be noteworthy.

Distributed and integrated propulsion concepts represent another key focus of this research. Efforts are encouraged that help define the relative performance of centralized propulsion mechanisms (traditional vehicle approach) versus distributed propulsion systems (energy conversion at the point of actuation) versus hybrid propulsion systems (part-centralized and part-distributed as exemplified by biological systems). While range and endurance requirements of microsystems may be low compared to traditional classes of vehicles, the reduced operational efficiency encountered at micro-scales is expected to put a significant burden on stored energy resources, inspiring a need to develop new propulsion systems that include unconventional methodologies for energy conversion.

For example, flapping and walking motion are generally more effective using cyclic linear motion, as opposed to rotary motion that has traditionally been used for larger vehicle propulsion. A great deal is known about high efficiency electrical motors, but no high-force, high-bandwidth large-displacement *linear* actuators currently exist that can efficiently propel flapping or walking vehicles of this size class. Such actuators could involve electrical-to-linear force conversion, but it may be advantageous to consider direct chemical-to-linear force actuation.

Important research issues include:

- Platform stability and control in high-disturbance environments
- Vortex-dominated unsteady aerodynamics of flapping wings at low Reynolds numbers
- Bio-inspired, bio-mimetic leg and wing concepts with integrated sensors and actuators, including bio-mimetic muscle actuators
- High-force high-bandwidth large-displacement linear actuators

Center on Processing for Autonomous Operation

Research is needed to provide the fundamental underpinnings for autonomous operation of distributed, mobile, multi-modal sensing micro-systems. These systems must operate under severe constraints on power and energy, and communications bandwidth, while achieving networked systems-wide goals. Nodes must be controlled at the individual and group level, adaptively navigate in a non-benign environment, and cooperate in groups, in semi- and full autonomy. Multi-modal sensing and distributed signal processing are needed that efficiently

extract information, for both intra and inter-node communication, and to support mobility, communications, and surveillance. Artificial intelligence, capable of learning and adapting, should enable the individual and group goals. Underlying communications modalities should balance power and system performance, incorporate integrated communications and sensing, and operate robustly in non-benign environments. Communications networks should provide the foundation for the systems distributed adaptive mobile operation, including heterogeneous nodes, asymmetric networking and control, and interfacing with the macro world including humans and larger platforms.

Important research issues include:

- Autonomous and semi-autonomous navigation and control over a network, group cooperative behavior and planning, robust and scalable control architectures, and geolocation.
- Learning, artificial intelligence, sensing and sensor signal processing; integrated sensing to support mobility, communications, and surveillance; efficient sensing and information extraction and utilization, and constrained information management within a node.
- Distributed signal processing, including low complexity techniques for distributed multi-modal sensing and fusion, and dynamic collaborative processing accounting for sporadic sensing and sensor management, as well as mobility.
- Communications and networking, including novel communications modalities, dual sensing and communications and implicit communication, lightweight robust and possibly asymmetric networking, integrated cross-layer communications and network design, and network lifetime extension.

Particular emphasis should be placed on developing analytical frameworks, modeling and simulation techniques, and experimental methods that are tightly coupled and support the overall micro-systems goals. The developed methods must address autonomous behavior and intelligence; the sensing and communications techniques and associated system architectures; the integration of actuation control with sensing, communications, and mobility; and fundamental limits and performance tradeoffs under communications and power/energy constraints.

Center on Microelectronics

To enable power efficient multi-functional sensing, ambulatory control, and reconfigurable networked response in mobile micro-scale platforms advancements are necessary in the areas of *novel* electronic, electro-optic, and electro-mechanical devices, circuit architectures, and materials. The constraints of small size and limited power require the development of simple but robust concepts that employ approaches beyond standard microelectronics circuitry and systems operation. For example, mixed signal (combined analog and digital) information processing and communication, and the investigation of bio-mimetic circuit architecture approaches may be necessary to enable functionality within the limits of power and thermal management. A wide variety of sensors will be required both for the mobile, networked microsystem platform and the payload that it carries. The need for low power, stable oscillators is envisioned to enable duty cycling for both electronic processing and communications, and to support geolocation for mobile robotic systems. Antennas and other transmit/receive concepts operating at frequencies outside of the conventional radio frequency spectrum may be required for short distance communication between platforms, and the unique electronics challenges of multi-scale

communications must be identified and resolved. These may include the development of practical low-power switchable filter banks to enable networked communication at multiple length scales. Novel signal processing approaches may be required to enhance the selectivity of sensors and reduce false positive readings, as well as distill essential information to reduce transmission power and enhance response efficiency.

Smart materials that exhibit multifunctionality may enable sensing, mobility, and communications objectives. Significant advances in the nanoscale engineering of materials and physical mechanisms may be required to achieve the structural, optical and electronic properties in such materials and enable low-power functionality. For example, resonant behavior suitable for filtering can be realized by patterning a dielectric as an artificial crystal. Heterogeneous integration, including the investigation of atomic interfaces, will likely be required to form useful structures or devices with reliable and robust performance. For example, piezoelectric materials may be employed as or integrated into structural components such as flapping wings or vibratory/resonant structural components to capture and convert the dynamic mechanical energy into electrical energy to power sensors located on or near those components.

Concepts for integrating power management or generation at the device, circuit, or sub-system level should consider distributed versus localized strategies, as well as management of associated duty cycles which may be optimized across varying mission scenarios to ensure the appropriate and efficient use of power that features a prioritized scheme.

An investigation of the fundamental physical limits of relevant electronic, mechanical, optical, and structural issues should be considered in the context of potential trade-offs in operational performance. These include, but are not limited to, sensed information processing, signal filtering, transmission, and receipt at relevant length scales, impedance matching, and noise sources within system-level size, weight, and power constraints which are expected to be severe and endemic. The need for radical design and engineering methodologies is envisioned in which system-level performance, maneuvering, and functional adaptability are emphasized over the optimization of individual functions.

Important research issues include:

- Synthesis and development of three-dimensional materials and circuit architectures for sensing, signal processing, and communications, which extend electronics and sensor capability beyond the traditional constraints of planar chip-based integrated circuitry
- Development of smart multifunctional materials for applications that may include, but are not limited to, structure, transport, memory and data storage, sensing, actuation, logic, communication, power generation and energy storage, self-healing, and thermal management
- Robust, low complexity, low power devices for sensing, signal processing and networked communications, e.g. radios, transceivers, sensors, analog & mixed signal devices and electronics (mixers, signal processors)
- Power and duty cycle management concepts at the device or circuit level, or hybrid power systems or energy harvesting concepts that are integrated into a platform-appropriate microelectronics circuit

Effort in this area should be tempered and driven by the following pervasive concepts: novel and autonomous application-specific technologies will be needed; the integration of materials, devices, and components must be multi-scaled and multi-level; and modeling, simulation, and performance analysis must accompany, shape, and interpret experimental progress.

Integration

Integration and experimentation are the keystones to generating empirical data, providing feedback to Principal Members, and insuring the design process is iterative. As the Lead for the Consortium, the Principal Member for Integration has primary responsibility for articulating and executing a vision on cross-Consortium integration. The Lead is expected to integrate the disparate technologies delivered by the Centers for experiments and to guide Center investigations based on collected data. The Lead is therefore responsible for coordinating crosscutting themes with Principal Members

To achieve the capabilities described in the operational scenarios, a designer needs to understand and exploit the inter-platform and intra-platform interactions and efficiencies in a collaborative ensemble of microsystems. Successful demonstration of operational capabilities requires radical design and engineering methodologies in which system-level performance is emphasized over the optimization of individual functions.

Successful integration requires an over-arching architecture for the collection of microsystems and the functionality of each platform. Challenges to establishing this architecture include balancing traditional goals of function, performance, and cost against non-traditional engineering goals such as flexibility, robustness, scalability, and sustainability. Further, it is necessary to understand the relationships or trade-offs between goals, system characteristics, and physical structure, e.g., performance vs. flexibility trade-offs. Critical to microsystem technology is that platform size, weight, and power dictate solutions that are not scaled versions of larger platforms.

To achieve the required understanding to define a microsystem architecture one may have to determine fundamental physical limits, define parametric representations of systems and subsystems, model system and subsystem interactions, develop design tools to examine tradeoffs, or develop scalable system design. Achieving fundamental understanding requires input from the Centers as does designing reliable experiments to validate parametric representations and models, or to test assumptions on single and multiple platforms.

A fundamental challenge is balancing modularity against integration. The needs and priorities for integration should be guided by anticipated gains in mission capabilities and should outweigh benefits gained through modularity. This will dictate whether it is best to design a special purpose platform versus one that has plug-and-play payloads, or whether it is better to design a module to have multifunctionality or optimize its performance for a single function.

Given the significant constraints placed upon microsystems-based platforms with regard to scale and payload capability, efficiencies in size and weight for all integrated components are key drivers for achieving the associated mission technical objectives with a minimum of weight and

scale. The development of functional packaging concepts (e.g., the design and use of husks that serve as structural protection in transit but may deploy on-site for increased platform stability and/or support for sensor arrays), as well as the material-based efficiencies that may be realized through direct integration with the platform, are considered vital areas of focus for achieving improvements in integration efficiencies.

An example of the efficiencies envisioned include shifts or redistribution of material associated with sensing and electronic payload into structural platform components to achieve a desired benefit in power to weight ratios with a concomitant improvement in sensing capability (e.g., higher power, longer endurance). Integration concepts should further consider biomimetic or bio-inspired systems strategies that may offer enabling technologies for engineered microsystems by virtue of their efficient structural shapes, materials, and multi-functional designs, and how these natural designs facilitate specific performance objectives for the given mission of the system. However, such structural efficiencies need to be balanced by the negative effects of high density, heterogeneous integration such as the generation of heat.

Important integration research issues include:

- Microsystems architectures modeling & simulation, including design tools
- Experimentation and analysis
- Sub-system interactions (e.g., platform thermal and acoustic signature management)
- Functional packaging and multi-functional structures and materials

Funding

The following represents the estimated funding levels for the Fundamental Research Component to be conducted under the Cooperative Agreement. (This includes all costs associated with the Cooperative Agreement, i.e. the research costs, costs to manage the program, etc.) As a reminder, the funding levels provided in this PA are for proposal preparation purposes. The actual funding levels for Cooperative Agreement will be updated annually after the US appropriation processes. Further, during performance, the funding levels between the four research areas set forth below may fluctuate slightly, as appropriate to meet the goals of the MAST CTA.

RESEARCH AREAS	Fiscal Year											
	FY07	FY08	FY09	FY10	FY11	**Total (5yr)**	FY12	FY13	FY14	FY15	FY16	**Total (10yr)**
Microsystem Mechanics Center	2.50	2.50	2.50	2.50	2.50	**12.50**	2.50	2.50	2.50	2.50	2.50	**25.00**
Processing for Autonomous Operation Center	2.50	2.50	2.50	2.50	2.50	**12.50**	2.50	2.50	2.50	2.50	2.50	**25.00**
Microelectronics Center	2.50	2.50	2.50	2.50	2.50	**12.50**	2.50	2.50	2.50	2.50	2.50	**25.00**
Integration	2.50	2.50	2.50	2.50	2.50	**12.50**	2.50	2.50	2.50	2.50	2.50	**25.00**
Total	10.00	10.00	10.00	10.00	10.00	**50.00**	10.00	10.00	10.00	10.00	10.00	**100.00**

Table 1. 6.1 Basic Research Funding

PART IV
TECHNOLOGY TRANSITION COMPONENT

This PA contains a requirement for a Technology Transition Component to augment the Fundamental Research Component. The results of the Fundamental Research Component will be transitioned under a procurement contract. This contract will be awarded to the Lead of the Consortium, the Principal Member for Integration. The Lead is expected to subcontract with other entities (both members of the Consortium and other organizations as appropriate) to achieve the technology transition efforts. A separate proposal for the Technology Transition Component is required to coincide with the proposed Fundamental Research Component for those offerors proposing to be the Lead Member of the Consortium. The following represents a discussion of the Technology Transition Component that will be incorporated into the contract as the umbrella scope under which individual, specific tasks will be negotiated and issued, when transition opportunities arise and the appropriate type of funding for such is identified.

Background

The contract is intended to provide analytical resources and support to exploit technology transition opportunities that arise from the Fundamental Research Component of the MAST CTA. This instrument will provide a mechanism to expeditiously transition the results of efforts performed under the Fundamental Research Component. The goal of the Technology Transition Component is to facilitate movement of the research further along the acquisition cycle toward specific applications.

Objective

The contractor shall support the MAST CTA in pursuing and performing technology transition efforts. Technology transition is the exploitation of results generated under the Fundamental Research Component in specific applications of interest to the Army. Specifically, the contractor shall perform individual tasks relating to the following objectives:

- To respond to ARL or other government customers who wish to alter, modify, augment, accelerate, and/or expand specific results of the Fundamental Research Component in order to fulfill a specific developmental requirement; and
- To respond to ARL or other government customers who have requirements for the expertise and/or results emerging from the Fundamental Research Component, and the integration of those results on the customer's application; and
- To join with ARL or other appropriate government customers in bringing technology from the Fundamental Research Component to a planned demonstration or exercise as appropriate.

Scope

The following describes a sampling of the types of technology transition tasks envisioned to support the objectives above:

- The contractor shall: (a) conduct specialized analyses, studies, and experimentation necessary to assess the applicability of technology; and (b) develop specific plans for the transfer of technology to targeted applications.
- The contractor shall: (a) prepare descriptive material that clearly details the scope, limitations, and requirements for implementing the specific technology; (b) provide an exemplar of the technology for incorporation into the target system for demonstration and/or experimentation as appropriate; and (c) assist in the integration of the technology into the target platform (platform could be computer software, as well as a physical entity) for demonstration and/or experimentation as appropriate.
- The contractor shall perform demonstrations and field experiments as required to promote transitioning of the technologies developed under the Fundamental Research Component. The statement of work for the tasks will be expected to define the mechanism for the demonstration or experiments as appropriate.

Reports

All reports shall meet normal professional quality standards. The following are examples of reports which may be required for a task: Technical Study Reports, Software Design Documentation, Software Systems Manuals, Interface Design Documentation, Interface Requirements, Database Design Documentation, Engineering Drawings, Engineering Specifications, Engineering Change Documentation, Workshop and Conference Reports, Instructor/Lesson Guides, etc.

- The contractor shall submit performance and cost reports, when required by the particular task that reflects the number of labor hours and labor costs charged against the task, cost of materials, travel, per diem, and total cost accumulated under the task. This report shall include the current status of the work, problem areas encountered, current projections of completion dates and estimated total cost to complete the order. Any changes to previous projections shall be explained.
- The contractor shall submit progress/meeting reports, when required by the task.
- The contractor shall submit status reports, when required by the task.
- The contractor shall submit technical progress reports, when required by the task.

Funding

It is expected that ARL and appropriate Other Government Agencies/Departments (OGA/OGD), as well as other ARL customer organizations having appropriate and relevant taskings to be performed, will provide the funding to the Consortium for transitioning technology to specific applications under the contract. No specific funding has been budgeted for the contract, and future budgetary efforts will be dependent on the success of the efforts under the Fundamental Research Component, as well as other events that may dictate the budgetary process. No funding from the Fundamental Research Component under the cooperative agreement shall be used for transition. The ceiling amount for the potential ten-year period of performance for the contractor in connection with the contract to be awarded is $80 million.

PART V
COLLABORATION

Background

Experience has shown that for many emerging technologies, high payoff is achieved through collaboration with a broad science and technology community. The US Army Collaborative Technology Alliances (CTAs), which were designed to encourage collaboration, are proving to be a successful model for collaborative technology development. The MAST CTA continues the ARL concept of an Alliance to facilitate a close relationship between ARL and its partners so that collaborative research can leverage and enhance individual efforts. It is ARL's strong belief that work conducted under the MAST CTA cannot be successful either in whole or in part without collaboration. That is, collaboration between the members of the Consortium and the Government Members of the Alliance is integral to the execution of the Fundamental Research Component, especially the crosscutting themes identified in **Part III**. Creation of an environment that is conducive to collaboration is therefore a critical element in establishing the Alliance. This section describes potential means to establish a collaborative environment including outreach activities and an on-line presence wherein scientific ideas can be exchanged efficiently in an open environment among all the partners in the Alliance.

HBCU/MI Collaboration

Meaningful involvement of Historically Black College or Universities or other Minority Institutions (HBCU/MIs) is mandatory. Specific collaborative efforts and outreach programs with HBCU/MIs are expected to be identified in each proposal. This will include significant HBCU/MI involvement in the execution and management of the Fundamental Research Component. Proposals are also requested to identify other programs that are aimed at significantly improving the participation of HBCU/MI staff in the Fundamental Research Component, as well as programs aimed at improving the training of HBCU/MI students.

Lectures and Workshops

The Alliance (i.e., the Consortium and ARL) may hold, from time to time throughout the period of performance of the MAST CTA Program, technical lectures and workshops on mutually agreed upon topics. The lectures and workshops should be open to all appropriate personnel. The costs associated with the Consortium's efforts for these lectures and workshops will be funded under the Cooperative Agreement.

Education

As a means to foster the professional growth and technical strength of ARL and to provide a source for training personnel in fields underlying the Alliance, the Consortium will identify educational opportunities for Government scientists and engineers who perform research and development in fields related to the Fundamental Research Component. These opportunities may include fellowship programs that lead to masters and doctoral degrees, and short courses

(e.g., summer and intensive special topic courses in critical technology areas) that lead to the award of appropriate academic credit.

The Consortium will further consider means to foster collaboration with ARL technical staff through programs such as internships at ARL for graduate and undergraduate students, and sabbaticals and summer study for faculty. The costs associated with the Consortium's efforts to identify, prepare for and execute such educational opportunities will be funded under the Cooperative Agreement. The cost associated with salaries, travel, etc. for Government personnel will be the responsibility of the Government, and will not be funded under the Cooperative Agreement.

Staff Rotation

A foundation of the CTA process is the rotation of technical staff through short- and long-term temporary assignments among the Alliance members, and particularly rotations between the government members and the private sector members. This staff rotation will be undertaken to foster and facilitate collaborative research where face-to-face interaction is advantageous, to enable a researcher to utilize unique facilities, and to facilitate the exchange of research results. In addition, this exchange, or cross fertilization, of personnel will provide Alliance personnel with insight into ARL unique requirements and will provide Government personnel with insight into commercial practices or the opportunity to pursue fundamental research with noted researchers. The success of these interactive and collaborative exchanges will be assessed by the quality of the collaboration as demonstrated by joint efforts such as progress reports, papers, patents, and presentations.

All salary and travel costs associated with the rotation of Government personnel will be borne by the Government. All salary and travel costs associated with staff rotations of Consortium members will be funded under the Cooperative Agreement or may be provided by the Consortium member as cost-share. It is anticipated that these rotations will be both of a short term (several weeks) and long term (one year or more), as well as intermittent rotations, and will be coupled with appropriate shorter periods of travel to optimize the output of collaborative research efforts. There should be a balance of staff rotations across all the partners in the Consortium and across all the technical areas in the Alliance. It is anticipated that some portion of the Consortium's technical labor-years will be in staff rotations.

Demonstrations

A key aspect of collaboration between the Consortium, Government members of the Alliance, and other Government entities, is the ability for the Consortium to convincingly demonstrate and showcase technologies developed under the MAST CTA. Demonstrations of technical progress include experiments to measure parameters necessary to construct and validate models, such as simulations, device fabrication, and hardware construction. As the program progresses, devices will be combined into sub-systems and into experimental systems to investigate ensuing interactions. Experimental demonstrations might be made to interested individual Government scientists and engineers, as well as to Army and DoD science and technology leaders with a need to understand the opportunities offered by the technologies under study in the MAST CTA. The

Army also expects to see progress towards achieving the capabilities described in the three given scenarios and expects this to lead to items that can be provided for warfighter experimentation.

Each Principal Member will be required to provide for such demonstrations during performance. Thus, offerors are requested to detail unique facilities, instrumentation, and laboratories that they expect to use to demonstrate research results developed under the MAST CTA. Such demonstration facilities may already exist or may be proposed for purchase under the MAST CTA within the funds allocated for each research area. Further, after award of the cooperative agreement, the Government intends to build on the demonstration capabilities and plans of each Principal Member by designating one site as the primary one for demonstrations that are central to the MAST CTA and can best showcase integrated technology solutions that result from the MAST CTA. Offerors are informed that, to enable the centralized demonstration site described, allocated funding may be shifted after cooperative agreement award.

PART VI
MANAGEMENT

Background

It is critical that the Consortium be structured and managed to create and foster an open, collaborative research environment and to facilitate the transition of technology. This section describes the Alliance and the Consortium, and their management.

Overall Management Concept

ARL and the winning Consortium will establish one collaborative research Alliance to address issues concerning the MAST CTA. Additionally, other Government agencies may be invited to join this Alliance and to contribute, as appropriate, their technical expertise and personnel, and to participate in the MAST CTA. Each Principal Member will be responsible for technical leadership in their respective research area, in coordination with the other Principal Members. In addition, the Principal Member for Integration (also the Lead of the Consortium) will distribute the funding for the Fundamental Research Component to all members (i.e. Principal and General) of the Consortium. Subawardee funding will be provided to the Consortium Member with which the Subawardee has or will have a legal relationship.

Technical Guidance and Oversight

The Alliance will be subject to the following technical guidance and oversight:

- An **Executive Steering Board (ESB)** will be established to address issues of US Army policy with respect to the MAST CTA's work. The ESB will include senior level Army personnel, who will meet annually to review the overall program and progress of the MAST CTA and provide macro level guidance on the direction of the program.

- **Collaborative Alliance Manager (CAM)**. The Fundamental Research Component executed under the MAST CTA will be considered an extension and integral part of the US Army Research Laboratory (ARL) research program. As such, the program established under this PA will be planned, defended, executed, and reviewed as part of ARL's mission program. Overall technical management and fiscal responsibility for the MAST CTA will reside with a senior ARL technical manager, who will be designated the CAM for the MAST CTA under the cooperative agreement. The individual designated as the CAM will also be designated as the Contracting Officer's Representative (COR) for the contract for the Technology Transition Component. The ARL Grants Officer/Contracting Officer will receive recommendations from the CAM/COR and will be the ultimate legal authority empowered to make formal adjustments in the MAST CTA, for both the cooperative agreement and the contract.

- **Program Director**. The MAST Program Director is the Consortium's technical representative charged with the Consortium's overall responsibility for management and guidance of the cooperative agreement. The Program Director will be from the organization

named as the Principal Member for Integration. The MAST CTA is expected to be the primary responsibility of the individual assigned as Program Director, and a commitment of time commensurate with this responsibility is also expected.

- **Center Directors**: Each research center will have a Center Director. The Center Director is the Center's technical representative charged with the Center's technical leadership, management, and guidance.

- A **Technical Management Group (TMG**) is chaired by the Collaborative Alliance Manager (CAM) and consists of the Program Director, the three Center Directors, as well as the corresponding Government technical leads. The TMG will assist the CAM and the Program Director in carrying out their duties concerning the MAST CTA.

- A **Research Management Board (RMB)** will be established to identify and develop collaborative opportunities, advise and assist the CAM in setting research goals, and facilitate transition to development programs. The RMB will include representatives from Army and other service organizations and other government agencies with interest, expertise, or both in technologies related to the MAST CTA. The RMB will be invited to the Annual Conference and the Annual Technical Review, and be informed about the Annual Program Plan approval process.

- **Consortium Management Committee (CMC).** The CTA will have a Consortium Management Committee (CMC) that consists of one representative from each Principal and General Member. The CAM participates as ex officio member in all discussions except those that deal with purely internal Consortium matters. The CMC will be chaired by a representative from the Principal Member for Integration, which is also the Lead of the Consortium. Each Principal Member will have one vote on the CMC to support programmatic and management-related activities and decisions. General Members are expected to be active participants in the CMC, but they do not have a vote. General Members are to be represented on the CMC for voting purposes by the Principal Member in the area under which they are a General Member. However, the Principal Member may select a proxy from among the General Members it represents to cast a vote when the Principal Member is unable. In the event of a tie, the Principal Member for Integration will cast the deciding vote. The CMC will be responsible for the management and integration of the Consortium's efforts under the MAST CTA including programmatic, technical, reporting, financial, and administrative matters. The CMC makes recommendations that concern the membership of the Consortium, the definition of the tasks and goals of the participants, and the distribution of funding to the participants. Quarterly meetings will be conducted by the CMC.

Articles of Collaboration

The Articles of Collaboration define the operational structure within the Consortium. The Articles of Collaboration governing the Consortium are provided in **Attachment 5** to the PA.

Initial Program Plan (IPP) and Annual Program Plan (APP).

Within 90 days after award, the Consortium (through the CMC) and the Government will jointly prepare an Initial Program Plan (IPP) to cover the first 12 months of performance. The IPP will be based substantially on the final proposals received by each of the four Principal Members prior to award of the Cooperative Agreement. Each of the Principal Members will share their proposed portion of the IPP with the other Principal Members. Through discussion among the Principal Members, an IPP will result that enables integration and execution of crosscutting themes that strive to achieve MAST CTA objectives. The IPP will be accompanied by a five-year roadmap that describes the overall plan to be accomplished by the Consortium within the Alliance structure. This roadmap should provide the vision for grand challenges and crosscutting themes to be addressed in the first five years. The roadmap should provide a detailed description of a well-coordinated theory and experimental program for the first two years; it should present and justify an appropriate balance between theory and experiments.

Eight months after award, the Consortium (through the CMC) and the Government will jointly prepare a proposed Annual Program Plan (APP) for the next annual period. As in the case of the IPP, each of the Principal Members will prepare their proposed portion of the APP and share such with the other Principal Members. Through discussion among the Principal Members, an APP will result that enables integration and execution of crosscutting themes that strive to achieve MAST CTA objectives. The ESB will provide guidance on the research directions of the Consortium to support US Army future forces requirements. The CAM will approve the APP and formally submit the approved APP to the Grants Officer for incorporation into the cooperative agreement. This process will continue through the life of the cooperative agreement.

The APP will cover a one-year timeframe, but may be altered, with the approval of the CAM and the Grants Officer, if research work requirements change. The APP will provide a detailed plan of research activities (including key personnel, educational opportunities, staff rotation, facilities, demonstrations and budget) that commits the Consortium to use their best efforts to meet specific research objectives. The APP will also describe the collaborative efforts with the Government. During the course of performance, if it appears that research goals will not be met, the CMC will provide a proposed adjustment to the APP, in coordination with the TMG, for approval by the CAM. In addition, the CAM may from time to time request that additional research be added to the APP within the scope of the cooperative agreement. The Consortium, as an entity, will not solicit or accept funding from outside sources other than the US ARL without the approval of the CAM and the Grants Officer.

During the course of performance, the Grants Officer, in coordination with the CAM, will have approval authority for certain specific changes to the IPP/APP including but not limited to:

a. Changes in the scope or the objective of the program, IPP/APP, or research milestones;

b. Change in the key personnel specified in the IPP/APP;

c. The absence for more than three months, or a 25% reduction in time devoted to the project, by the approved project director or principal investigator;

d. The need for additional Federal funding; and

e. Any sub-award, transfer, or contracting out of substantive program performance under an award, unless described in the IPP/APP.

The CAM, in coordination with the CMC and ARL management, will be responsible for integrating the IPP/APP into the overall respective research and technology programs.

During the course of performance, the Grants Officer, in coordination with the CAM, will have approval authority for certain specific changes to the cooperative agreement including, but not limited to:

- Changes to the Articles of Collaboration if such changes substantially alter the relationship of the parties as originally agreed upon;
- Solicitation or acceptance of funding under the agreement from sources other than ARL; and
- Changes in Consortium membership.

Annual Conference

The Alliance will be responsible for participating with ARL in an Annual Program Formulation Conference to display and present the results of its previous year's research and describe plans for the next year. Program overviews, posters, and exhibits and demonstrations will be presented, displayed, or both to communicate the research products of the MAST CTA. The Conference will foster interactions and collaborations among researchers. Planning for the Conference will be executed through the Principal Member for Integration (Consortium Lead) and the CAM.

Evaluation For Five-Year Extension

The MAST CTA will be awarded for a five-year period beginning in FY07. There will be an option to extend the MAST CTA for an additional five years. At the end of the fourth year, a program review will be conducted as directed by ARL. This review will consider cumulative performance metrics, the Consortium's vision for the additional five-year period of performance (to be submitted by the Consortium at the end of the fourth year), funding availability and the current fundamental research needs and goals of the US Army. Performance metrics are expected to include items that provide an indication of the MAST CTA's accomplishments, such as transitions, the number of refereed journal articles, invited presentations, relevance of the work to ARL, collaboration, staff rotation, education, management**,** etc. The decision as to whether to exercise the option is expected to be based on the results of the review and evaluation described above.

Collaboration Environment

The Lead must provide an environment that promotes the collaborative research and management of the Alliance. Such an environment might be a web-based, password-protected

system. The Lead will provide an Internet secure environment for information sharing and interactive collaboration. An information repository will be maintained where ongoing research results, published papers and reports, biennial research plans, interactive file sharing, discussion groups, interactive calendars of events, and other information can be accessed to enhance communication. This environment should support collaboration among Consortium members and between the Consortium and the Government and should support multi-level access control to protect sensitive information and intellectual property. The Consortium is expected to facilitate the integration and demonstration of integrated Alliance research results through this collaboration environment.

Tracking Technology Transfer

While it is expected that each Principal Member will actively pursue technology transition to the Government as part of executing the Fundamental Research Component, it will be the responsibility of the Lead to briefly document and report to the Government on technology transition opportunities and events as they result from the Fundamental Research Component.

Distribution of Funding

The Principal Member for Integration (also the Lead of the Consortium) will distribute the funding for the Fundamental Research Component to all members (i.e. Principal and General) of the Consortium. Subawardee funding will be provided to the Consortium Member with which the Subawardee has or will have a legal relationship.

PART VII
CONSORTIUM QUALIFICATIONS

Consortium Membership:

To be qualified, potential Consortium Members must:

- be judged to have adequate financial and technical resources, given those that would be made available through the cooperative agreement, to execute the program of activities envisioned,
- have no known recent record of lack of responsibility or serious deficiency in executing such programs or activities,
- have no known recent record indicating a lack of integrity or business ethics,
- be otherwise qualified and eligible to receive an award under applicable laws and regulations.

There are two levels of Consortium Members: Principal Members and General Members.

Principal Members: The Principal Members are defined as follows:

Principal Member for Integration (also the Consortium Lead) – expected (but not required) to be a US industrial concern with significant existing operations in order to support research and transition activities associated with the MAST CTA. Significant operations are defined as having the ability to perform research and support activities, utilizing in-house engineers and scientists. The Principal Member for Integration has primary responsibility for articulating and executing a vision on cross-Consortium integration. This Member is expected to articulate a vision for the CTA, promote collaboration among Principal Members, promote collaboration between Principal Members and members of Alliance, and coordinate crosscutting themes with Principal Members. This Member is required to administer, integrate, and manage the Consortium, participate in the research, and promote the transition of technologies resulting from the Fundamental Research Component of the MAST CTA. This includes distribution of Government funding to Consortium Members (directly to both the other Principal Members and the General Members) in accordance with the approved IPP/APP under the agreement. Leadership from this Member is expected to enhance the potential for transition of the resultant technology into both the commercial and military marketplaces.

Principal Members for the three Research Centers – Each Principal Member of the three research Centers is required to be an advanced degree-granting educational institution under the Higher Education Act of 1965 as amended. Further, the Principal Member will have doctoral level courses of study in related scientific and technical areas that can result in the granting of a doctoral degree. These Principal Members are expected to participate in the Fundamental Research Component with their researchers being substantially and meaningfully engaged in the MAST CTA. These Principal Members are also to promote the transition of technologies resulting from the Fundamental Research Component.

General Members:

Each Principal Member may identify General Members in their proposals to participate with them in the Fundamental Research Component. It is expected that each Principal Member will have no more than three General Members. In order to meet the goals of the MAST CTA, it will be necessary to maintain a critical mass of research capabilities; however, an excess number of members in one research areas may dilute the funding levels to the point that it renders the program goals unattainable. In order to be considered a General Member: (1) a long-term relationship with the organization is envisioned under the MAST CTA, wherein researchers are substantially and meaningfully engaged in the Fundamental Research Component; (2) said organization's input is considered necessary and beneficial for the strategic planning associated with the Fundamental Research Component; and (3) said organization is expected to be involved in transition.

Historically Black College or University/Minority Institution (HBCU/MI) Members: Army policy strongly encourages involvement of Historically Black Colleges and Universities (HBCU) or Minority Institutions (MI) in this effort. Accordingly, in each of the three research Centers the Principal Member or one or more of the three General Members must be an HBCU/MI. HBCU, as used in this PA, means institutions determined by the Secretary of Education to meet the requirements of 34 Code of Federal Regulations (CFR) Section 608.2. The term also means any nonprofit research institution that was an integral part of such a college or university before November 14, 1986. MI, as used in this PA, means institutions meeting the requirements of the Higher Education Act of 1965 as amended (20 U.S.C. 1067k(3)). The term also includes Hispanic-serving institutions as defined in such Act (20 U.S.C. 1101a). ***At least 10% of the funding for each research Center must be provided to HBCU/MI Member(s).***

Subawardees:

Principal and General Members may be augmented, e.g. with academic or industrial concerns, as necessary and appropriate to meet the goals of the MAST CTA. Subawardees are not considered Members of the Consortium. Subawardees are organizations that (1) may not be involved long-term in the MAST CTA; (2) are not expected to provide strategic input concerning the goals and direction of the MAST CTA; and (3) are expected to have limited involvement in transition.

Federally-Funded Research and Development Centers (FFRDCs):

FFRDCs may participate as General Members or Subawardees but may not function as a Principal Member. Further, FFRDCs must cost-share an amount equal to the funding to be provided to them under the MAST CTA.

Place of Performance for all Consortium Participants:

Performance by the Principal Member for Integration is limited to the US to facilitate technology transition. Other Principal Members, and all General Members and Subawardees, may be located and perform at any location. For example, a Principal Member (a Center) may be located and perform outside the US.

PART VIII
PROPOSAL PREPARATION AND SUBMISSION

Proposal Submission Information

Proposals must be submitted according to the instructions contained herein. **Proposals in connection with this PA are to be submitted to the delivery locations as specified below, by the time specified below.** Attachment 1 to the PA contains provisions for Late Submissions of Proposals.

Delivery Address:

Delivery Address A:
US Army RDECOM Acquisition Center
Research Triangle Park Contracting Division
ATTN: AMSRD-ACC-R (Linda Young)
4300 S. Miami Boulevard
Durham, NC 27703

Delivery Address B:
Mr. Patrick J. Emery (home office)
8539 Edenton Road
Fulton, MD 20759
Telephone: (301)604-5093

The proposal must be submitted directly to the delivery addresses by the specified time below:

Due date and Time: 25 October 2006, 2:00pm EDT

Each proposal for the three research Centers shall consist of the following:

- **hard copies of the separately bound proposal items/volumes listed below; and**
- **soft copies of the proposal on CDs in the format as called for below.**

(Note: Each of these items shall be separately bound.)

PROPOSALS FOR THE RESEARCH CENTERS **PROPOSAL ITEM/VOLUME**	**NUMBER OF COPIES – DELIVERY ADDRESS A**	**NUMBER OF COPIES – DELIVERY ADDRESS B**

Proposal Cover Sheet with Authorized Signature - (See Attachment 2) and Signatures of the Principal Member and all proposed General Members on the Articles of Collaboration Acknowledgment Coversheet (See Attachment 5.)	Qty 1 – original Qty 2 – hard copies Qty 1- CD*	Qty 12 - hard copies Qty 12- CD*
Fundamental Research Component Summary (A brief, up to 5 page abstract which summarizes the content of the Fundamental Research Component of the proposal.)	Qty 1 – original Qty 2 – hard copies Qty 1 – CD*	Qty 12 - hard copies Qty 12- CD*
Fundamental Research Component Volume** (to include Biographical Sketches and Signatures of the Principal Member and all proposed General Member on the Articles of Collaboration Acknowledgement Coversheet)	Qty 1 – original Qty 2 – hard copies Qty 1- CD*	Qty 12 - hard copies Qty 12- CD*
Technology Transition Component Volume**	Qty 1 – original Qty 2 – hard copies Qty 1- CD*	Qty 12 - hard copies Qty 12- CD*
Program Management Volume** (to include Biographical Sketches)	Qty 1 – original Qty 2 – hard copies Qty 1- CD*	Qty 12 - hard copies Qty 12- CD*
Cost Volume for Fundamental Research Component**	Qty 1 – original Qty 2 – hard copies	Qty 4 – hard copies
Completed Representations and Certifications (See Attachment 6.)	Qty 1 – original Qty 2- hard copies	None
Any Exceptions, Conditions or Comments concerning the Model Cooperative Agreement (See Attachment 3.)	Qty 1 - original Qty 2 – hard copies Qty 1 – CD*	Qty 2 – hard copies Qty 1- CD*

Each proposal for the research area of Integration shall consist of the following:

- **hard copies of the separately bound proposal items/volumes listed below; and**
- **soft copies of the proposal on CDs in the format as called for below.**

(Note: Each of these items shall be separately bound.)

INTEGRATION PROPOSALS **PROPOSAL ITEM/VOLUME**	**NUMBER OF COPIES – DELIVERY ADDRESS A**	**NUMBER OF COPIES – DELIVERY ADDRESS B**
Proposal Cover Sheet with Authorized Signature - (See Attachment 2) and Signatures of the Principal Member and all proposed General Members on the Articles of Collaboration Acknowledgement Coversheet (See Attachment 5.)	Qty 1 – original Qty 2 – hard copies Qty 1- CD*	Qty 12 – hard copies Qty 12 – CD*

Fundamental Research Component Summary (A brief, up to 5 page abstract which summarizes the content of the Research Component of the proposal.)	Qty 1 – original Qty 2 – hard copies Qty 1 – CD*	Qty 12 – hard copies Qty 12 – CD*
Fundamental Research Component Volume** (to include Biographical Sketches and Signatures of the Principal Member and all proposed General Member on the Articles of Collaboration Acknowledgement Coversheet)	Qty 1 – original Qty 2 – hard copies Qty 1- CD*	Qty 12 – hard copies Qty 12 – CD*
Technology Transition Component Volume**	Qty 1 – original Qty 2 – hard copies Qty 1- CD*	Qty 12 – hard copies Qty 12 – CD*
Program Management Volume** (to include Biographical Sketches)	Qty 1 – original Qty 2 – hard copies Qty 1- CD*	Qty 12 – hard copies Qty 12 – CD*
Cost Volume for Fundamental Research Component**	Qty 1 – original Qty 2 – hard copies	Qty 4 – hard copies
Completed Representations and Certifications (See Attachment 6.)	Qty 1 – original Qty 2 - hard copies	None
Completed Request for Proposal (for the Contract) (See Attachment 4.)	Qty 1 – original Qty 1- hard copies	Qty 1- hard copy
Any Exceptions, Conditions or Comments concerning the Model Cooperative Agreement (See Attachment 3.)	Qty 1- original Qty 2 – hard copies Qty 1 – CD*	Qty 2 – hard copies Qty 1 – CD*

*All proposal volumes provided on CD are to be in PDF format, with the exception of the Exceptions, Conditions or Comments concerning the Model Cooperative Agreement, which is to be provided in Word. The quantity of CDs set forth above represents the required number of copies on CD of the entire proposal. Separate CDs are not required for each Proposal Item/Volume, thus multiple Proposal Items/Volumes can be incorporated on a single CD. An index is to be provided as to the Proposal Items/Volumes included on each CD submitted.

******Each of these volumes shall contain a table of contents that is **not** included in the page limitations set forth below.

Proposal Format Information

Entire Proposal. The entire proposal (including all volumes) should be concise, utilizing one side of each page with no foldout pages. Specific page limitations for each volume are prescribed below. Each proposal must be typed (with type that is not smaller than 11 point or 12 pitch on standard 8 1/2" X 11" paper with one (1) inch margins, 6 lines per inch).

Fundamental Research Component Summary. The pages in the Fundamental Research Component Summary shall be numbered. The Fundamental Research Component Summary should be a brief abstract that summarizes the content of the Research Component of the proposal, the overall vision, the rationale for research topic selection and the crosscutting themes. The Fundamental Research Component Summary **shall not exceed 5 pages**, utilizing one side of the

page. Offerors are cautioned that pages in excess of the **5**-page limitation will not be included in the evaluation.

Fundamental Research Component Volume. The pages included in the Fundamental Research Component Volume shall be numbered. Offerors are advised that the Fundamental Research Component Volume of the proposal **shall not exceed 30 pages**, utilizing one side of the page.

A table listing all of the Principal Investigators (PI's)/Key Researchers and the number of hours per year that each PI will devote to research must be included and is part of the **30**-page maximum. This table should provide information for the first three years of the program, in the following format specified below.

PI/ Key Researcher Name	**Task / subtask Number (keyed to proposal)**	**Number of Hours* in Year 1**	**Number of Hours in Year 2**	**Number of Hours in Year 3**

(*This chart is to describe the effort in the number of actual hours, not calendar, academic or summer years.)

The **30**-page maximum does not include Biographical Sketches for key personnel, but does include figures and references. Biographical Sketches shall be included as an appendix to the volume and are limited to two (2) pages per person. Biographical sketches for all academic Principal Investigators (PIs)/Key Researchers shall also include information on current and pending support in the format specified below. The **30**-page maximum does not include the Current and Pending Support information. The Current and Pending Support information shall be included as an appendix to the volume and is limited to two (2) pages per person.

CURRENT AND PENDING SUPPORT
PI/Key Researcher Name:
Support: ____Current _____Pending _____Submission planned in the Near Future
Project/Proposal Title:
Source of Support:
Award Amount (or Annual Rate): $
Period Covered:
Location of Research:
Person-Months Committed to the Project: Calendar: Academic Year: Summer:
Description of Project:

Offerors are cautioned that pages in excess of the **30**-page limitation, pages in excess of the two-page limitation for the Biographical Sketches, and pages in excess of the two-page limitation for Current and Pending Support, will not be included in the evaluation.

Technology Transition Component Volume (Research Center Proposals). The pages included in the Technology Transition Component Volume shall be numbered. Offerors are advised that the Technology Transition Component Volume of the proposal **shall not exceed 10 pages**, utilizing one side of the page. The **10**-page maximum does not include biographical sketches for key personnel. Biographical sketches shall be limited to two (2) pages per person. Offerors are cautioned that pages in excess of the **10**-page limitation, and pages in excess of the two-page limitation for the Biographical Sketches, will not be included in the evaluation.

Technology Transition Component Volume (Integration Proposals). The pages included in the Technology Transition Component Volume shall be numbered. Offerors are advised that the Technology Transition Component Volume of the proposal **shall not exceed 20 pages**, utilizing one side of the page. The **20**-page maximum does not include biographical sketches for key personnel. Biographical sketches shall be limited to two (2) pages per person. Offerors are cautioned that pages in excess of the **20**-page limitation, and pages in excess of the two-page limitation for the Biographical Sketches, will not be included in the evaluation.

Program Management Volume (Research Center Proposals). The pages included in the Program Management Volume shall be numbered. Offerors are advised that the Program Management Volume of the proposal **shall not exceed 10 pages**, utilizing one side of the page. The 1**0**-page maximum does not include biographical sketches for key personnel. Biographical sketches shall be limited to two (2) pages per person. Offerors are cautioned that pages in excess of the 1**0**-page limitation, and pages in excess of the two-page limitation for the Biographical Sketches, will not be included in the evaluation.

Program Management Volume (Integration Proposals). The pages included in the Program Management Volume shall be numbered. Offerors are advised that the Program Management Volume of the proposal **shall not exceed 20 pages**, utilizing one side of the page. The **20**-page maximum does not include biographical sketches for key personnel. Biographical sketches shall be limited to two (2) pages per person. Offerors are cautioned that pages in excess of the **20**-page limitation, and pages in excess of the two-page limitation for the Biographical Sketches, will not be included in the evaluation.

Cost Volume. There is no page limit for the information provided for the cost volume. **Contents for the Cost Volume shall include the entire cost submission for the Fundamental Research Component for the first five years of performance. (The Consortium will be requested to provide a complete cost proposal for the optional five-year period of performance as part of the evaluation to be completed prior to making the decision concerning this optional period.)** The cost portion of the proposal shall contain cost estimates sufficiently detailed for meaningful evaluation. For budget purposes, assume a performance start date of **1 May 2007.** The proposed amounts shall not exceed the funding ceilings identified in **PART III - FUNDAMENTAL**

RESEARCH COMPONENT of this PA. Budgets must be presented by cost elements as detailed below.

The estimated costs must be broken down to show the following:

- Direct labor categories, labor rates and labor hours associated with the effort.
- An itemized list of permanent equipment to be acquired showing the cost of each item. Permanent equipment is any article of non-expendable tangible personal property having a useful life of more than two years, and an acquisition cost of $1,000 or more per unit.
- Education and staff rotation costs.
- A general description and total estimated cost of expendable equipment and supplies.
- Contemplated expenditures for travel with brief explanation of purpose. Estimated costs should include destination, number of people, number of days, airfare, per diem and transportation.
- Other direct costs (e.g., publications, computer costs, insurance).
- Cost for consulting services, if any, showing number of days, daily rate, and estimated travel/per diem costs. The need for consulting services must be fully justified.
- For proposed sub-awards, a description of services or materials that are to be awarded by sub-agreement. For awards totaling $10,000 or more, provide the following specific information:
    - If known, the identification of the proposed subawardee and an explanation of why and how the subawardee was selected or will be selected.
    - Whether or not the award will be competitive and, if noncompetitive, rationale to justify the absence of competition.
    - The proposed cost in sufficient detail to allow for meaningful evaluation, i.e., an elemental breakdown of cost comparable to that required for any other awardee.
- Indirect rates and associated costs, and the timeframes to which they are applicable.
- A clear identification and explanation of any proposed cost-sharing costs and cost-sharing arrangement, to include the amount or ratio of cost share, when such cost share will be provided, and the evidence of a commitment from the offeror to provide such a cost share. No level of cost sharing is stipulated. Cost sharing will be evaluated based on the degree to which the proposed cost sharing enhances the proposal.

Marking Proposals

The proposal submitted in response to this solicitation may contain technical and other data that the offeror does not want disclosed to the public or used by the US Government for any purpose other than proposal evaluation. Information contained in unsuccessful proposals will remain the property of the offeror except for that evidenced in the Proposal Cover Page and Project Summary. The Government may, however, retain copies of all proposals. Public release of information in any proposal submitted will be subject to applicable statutory and regulatory requirements.

If proprietary information which constitutes a trade secret, proprietary commercial or financial information, confidential personal information, or data affecting the national security, is provided by an offeror in a proposal, it will be treated in confidence, to the extent permitted by law, provided that the following legend appears and is completed on the front of the proposal:

> *For any purpose other than to evaluate the proposal, this data shall not be disclosed outside the US Government and shall not be duplicated, used, or disclosed in whole or in part, provided that if an award is made to the offeror as a result of or in connection with the submission of this data, the Government shall have the right to duplicate, use or disclose the data to the extent provided in the agreement. This restriction does not limit the Government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained in page(s) _____ of this proposal.*

Any other legend may be unacceptable to the Government and may constitute grounds for removing the proposal from further consideration and without assuming any liability for inadvertent disclosure. The Government will limit dissemination of properly marked information to within official channels.

In addition, the pages indicated as restricted must be marked with the following legend:

> *Use or disclosure of the proposal data on lines specifically identified by asterisk (*) are subject to the restriction on the front page of this proposal.*

The Government assume no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

In the event properly marked data contained in a proposal in response to this solicitation is requested pursuant to the US Freedom of Information Act, 5 USC 552, the offeror will be advised of such request and prior to such release of information will be requested to expeditiously submit to ARL a detailed listing of all information in the proposal which the offeror believes to be exempt from disclosure under the Act. Such action and cooperation on the part of the offeror will ensure that any information released by ARL pursuant to the Act is properly determined.

PART IX
EVALUATION AND AWARD

All information necessary for the review and evaluation of a proposal must be contained in the proposal. No other material will be provided to the evaluators. Proposals should contain sufficient technical detail to allow for in-depth technical evaluation.

An initial review of the proposals will be conducted to ensure compliance with the requirements of this PA. Failure to comply with the requirements of the PA may result in a proposal receiving no further consideration for award.

A Source Selection Evaluation Board (SSEB) will review the proposals. The SSEB, consisting of qualified groups of scientists, managers, and cost specialists, will evaluate each proposal and provide the results of that evaluation to the Source Selection Authority (SSA). The SSA will make decisions concerning the competitive range and award selection.

If negotiation discussions are held, ARL anticipates such to be located at the site of each offeror. Any such meetings will be coordinated with the offerors at the appropriate time.

Proposals submitted in response to this PA will be evaluated against the evaluation factors set forth below, using an adjectival and color rating system. Cost will be evaluated for realism, reasonableness, and affordability. Evaluators will identify strengths, weaknesses and clarifications concerning the proposal. Information from any and all proposal volumes may be used for any and all evaluation areas described above.

Each proposal must be submitted under one of the four research areas and will address primarily the specific research challenges and goals appropriate to that area. Because there are acknowledged technical overlaps between the areas, and because the program specifically requires collaboration and cooperative progress towards a common goal, each proposal should address specific and potential collaborative research projects with other areas, noting what contribution would be made towards research goals of the other areas and vice versa.

PROPOSALS FOR RESEARCH CENTERS

Fundamental Research Component

Proposals submitted in connection with the three research Centers will be evaluated using Factors (a) through (h) as set forth below:

Factor (a): Technical Merit. Evaluation of this factor will concentrate on the overall scientific and technical merit, creativity and innovation of the proposed research in light of the state-of-the-art of current related technologies. The proposal should include a complete technical discussion stating the background and objectives of the proposed research, the technical approaches to be pursued, the parties involved and the level of effort to be employed (demonstrating that researchers are substantially and meaningfully engaged in the

research efforts.) The proposal should clearly identify specific technical challenges that relate to fundamental understanding of the root cause of difficult military problems and should provide evidence that the proposed technical approaches can address these technical challenges in a measured approach across the near-, mid-, and far-term. The proposal should explain how the offeror will develop a creative approach to finding solutions to these challenges, and how the proposed research will, when brought together with the other research to be performed by the Consortium, contribute to the overall goal of making progress toward more integrated solutions.

Factor (b): Collaboration. Evaluation of this factor will include evidence of previous successful collaborative efforts and the offeror's commitment and plans to collaboration under the MAST CTA. The proposal should include examples of how researchers have successfully collaborated previously in similar programs. Further, the proposal should include plans for how researchers will collaborate within the Center and with the other Centers and the Integrator. This includes how the proposed research is expected to feed, be fed by, or in some other way link with, research being performed elsewhere within the Consortium, and within the Government (which includes ARL, other Army organizations, other military service organizations, and other government agencies.)

Factor (c): Relevance. Evaluation of this factor will focus on how well the proposed research responds to the US Army's Vision and the Army's requirements to achieve that Vision. The US Army Vision may be found at the US Army homepage: www.army.mil. Thus, the proposal should include a discussion of how the proposed research relates to, and supports, the Army Vision.

Factor (d): Facilities and Equipment. Evaluation of this factor will determine the extent to which the offeror's proposed facilities and equipment will contribute to the accomplishment of the proposed research and support demonstrations of the resulting technology. Thus, the proposal should include a description of the facilities to be used for the research and demonstrations, who will have access to these facilities, and how such will enhance the research efforts proposed.

Factor (e): Credentials. Evaluation of this factor will review the qualifications, capabilities, availability, and experience of both the offeror's proposed research personnel (all proposed members and subawardees) individually and as a whole, their relevant past accomplishments, and their ability to achieve the proposed technical objectives. The proposal should include the names, brief biographies and availability of the key personnel who will be involved in the research. Such credentials, as documented on the biosketches, shall include, among others, a record of seminal publications in the scientific literature and a record of successful program deliverables and transitions.

Technology Transition Component

Factor (f): Past Performance. Evaluation of this factor will focus on the offeror's demonstrated ability and experience in transitioning technologies from the research stage into development programs. Thus, the proposal should include examples of successful past

transitioning experiences, including the points of contact (names, addresses, and telephone numbers) of individuals in other government organizations that can attest to the success of these examples.

Factor (g): Plan to execute. Evaluation of this factor will focus on the proposed plan to promote rapid transition of the research products into US Army development programs as well as commercial applications. Thus, the proposal should include a description of the planned process for transition.

Management

Factor (h): Management. Evaluation of this factor will focus on the offeror's plan to comply with the requirements of the overall management concept, programmatic details, and the leadership and management to be provided for its Research Center.

PROPOSALS FOR INTEGRATION

Proposals submitted in connection with the research area of Integration will be evaluated using Factors (a) through (i) as set forth below.

Fundamental Research Component

Factor (a): Technical Merit. Evaluation of this factor will concentrate on the overall scientific and technical merit, creativity and innovation, of the proposed research in light of the state-of-the-art of current related technologies. Further, evaluation of this factor will include the proposed vision in microsystems and evidence of research acumen in integration and developing modeling and simulation tools. The proposal should include a complete technical discussion stating the background and objectives of the proposed research, the technical approaches to be pursued, the parties involved and the level of effort to be employed (demonstrating that researchers are substantially and meaningfully engaged in the research efforts.) The proposal should clearly identify specific technical challenges that relate to fundamental understanding of the root cause of difficult military problems and should provide evidence that the proposed technical approaches can address these technical challenges. The proposal should explain how the offeror will develop a creative approach to finding solutions to these challenges in a measured approach across the near-, mid-, and far-term, and how the proposed research will, when brought together with the other research to be performed by the Consortium, contribute to the overall goal of making progress toward more integrated solutions. The Principal Member for Integration is expected to execute a technical and research program however, as Consortium Lead, the breadth of this program is expected to be less than that of the Research Centers.

Factor (b): Collaboration. Evaluation of this factor will include evidence of previous successful collaborative efforts and the offeror's commitment and plans to collaboration under the MAST CTA. Evaluation of this factor will also include evidence of the offeror's ability to lead multi-disciplinary researchers as an integrated team working collaboratively. The proposal should include examples of how researchers have successfully collaborated

previously in similar programs. Further, proposals should include plans for how researchers will collaborate in research efforts involving Integration and how they will collaborate with the Research Centers. This includes how the proposed research is expected to feed, be fed by, or in some other way link with, research being performed elsewhere within the Consortium, and within the Government (which includes ARL, other Army organizations, other military service organizations, and other government agencies).

Factor (c): Relevance. Evaluation of this factor will focus on how well the proposed research responds to the US Army's Vision and the Army's requirements to achieve that Vision. The US Army Vision may be found at the US Army homepage: www.army.mil. Thus, the proposal should include a discussion of how the proposed research relates to, and supports, the Army Vision.

Factor (d): Facilities and Equipment. Evaluation of this factor will determine the extent to which the offeror's proposed facilities and equipment will contribute to the accomplishment of the proposed research and support demonstrations of the resulting technology. Thus, the proposal should include a description of the facilities to be used for the research and demonstrations, who will have access to these facilities, and how such will enhance the research efforts proposed.

Factor (e): Credentials. Evaluation of this factor will review the qualifications, capabilities, availability, and experience of both the offeror's proposed research personnel (all proposed members and subawardees) individually and as a whole, their relevant past accomplishments, and their ability to achieve the proposed technical objectives. The proposal should include the names, brief biographies and availability of the key personnel who will be involved in the research. Such credentials, as documented on the biosketches, shall include, among others, a record of seminal publications in the scientific literature and a record of successful program deliverables and transitions.

Technology Transition Component

Factor (f): Past Performance. Evaluation of this factor will focus on the offeror's demonstrated ability and experience in transitioning technologies from the research stage into development programs. Thus, the proposal should include examples of successful past or current transitioning experience, and provide the contract number(s) and point(s) of contact (names, addresses, and telephone numbers) of Government personnel who can attest to the success of these examples. Offerors are encouraged to provide information on problems encountered on the identified contracts and the offeror's corrective actions. Offerors without a record of relevant past performance or for whom information on past performance is not available, will not be evaluated favorably or unfavorably for this evaluation factor.

Factor (g): Plan to execute. Evaluation of this factor will focus on the proposed plan to promote rapid transition of the research products into US Army development programs as well as commercial applications. Thus, the proposal should include a description of the planned process for transition.

Factor (h): Subcontracting. Evaluation of this factor will focus on the offeror's past performance in meeting subcontracting plan goals, including specifically their small business goals and their small disadvantaged business goals. Offerors should provide contract number(s) and point(s) of contact of Government personnel who can attest to this information. Offerors without a record of relevant past performance or for whom information on past performance is not available, will not be evaluated favorably or unfavorably for this evaluation factor. While the specific transition tasks to be performed are dependent on the results of the research program and are not yet known, evaluation of this factor will also include the offeror's plan for subcontracting, specifically identifying planned types of efforts to be performed by small businesses, small disadvantaged businesses and HBCU/MIs. With respect to the subcontracting evaluation factor, offerors that are small businesses will receive the highest rating.

Management

Factor (i): Management. Evaluation of this factor will focus on the offeror's plan to comply with the requirements of the overall management concept, programmatic details, the leadership and management to be provided by the Program Director, timely submission of consortium invoices, and the establishment of tools to create a collaboration environment as set forth in **PART VI – MANAGEMENT**. This includes plans for collaboration and efforts to bring about a unity of vision from the four Principal Members. Thus, the proposal must include a plan for efficient management of the MAST CTA, addressing all of these requirements.

Cost

While this area will not be weighted, evaluation of this area will consider cost realism, cost reasonableness, and affordability within funding constraints. The Government may make adjustments to the cost of the total proposed effort as deemed necessary to reflect what the effort should cost. These adjustments shall consider the task undertaken and technical approach proposed. These adjustments may include upward or downward adjustments to proposed labor hours, labor rates, quantity of materials, price of materials, overhead rates and G&A, etc.

Relative Importance of Evaluation Criteria

The relative importance of the evaluation factors within this PA are as set forth below:

PROPOSALS for the RESEARCH CENTERS:

The combined weight of the evaluation factors associated with the Fundamental Research Component is significantly more than the combined weight of the evaluation factors associated with the Technology Transition Component and Management. Within the Fundamental Research Component, Evaluation Factors (a) through (e) are listed in descending order of importance, with Factor (a) being the most important and Factors (b), (c) and (d) being of approximately equal importance. Within the Technology Transition Component, Evaluation Factors (f) and (g) are approximately equal in importance.

PROPOSALS for INTEGRATION:

The combined weight of the evaluation factors associated with the Fundamental Research Component is more than the combined weight of the evaluation factors associated with both the Technology Transition Component and Management. Within the Fundamental Research Component, Evaluation Factors (a) through (e) are listed in descending order of importance, with Factors (a) and (b) being of approximately equal importance and Factors (c) and (d) being of approximately equal importance. Within the Technology Transition Component, Evaluation Factors (f), (g) and (h) are approximately equal in importance.

Basis of Award

Proposals received in response to this solicitation will be evaluated using formal source selection procedures. Award will be based on an integrated assessment of each offeror's ability to satisfy the requirements of the PA. The Government anticipates that discussions with offerors will be conducted; however, the Government reserves the right to make award without discussions. A competitive range may be established for any discussions. If discussions are held, offerors in the competitive range will be invited to submit Final Proposal Revisions, which will be evaluated using the same procedures used with the initial proposals. The Government will make award to the Consortium (consisting of the four Principal Members selected for award, and any General Members included in their proposals) that offers the best value to the Government, conforming to the PA, cost and other factors considered. The Government reserves the right to make award to a Principal Member whose proposal is relatively close in overall merit to other proposal(s) received, but that proposal offers more synergistic value when combined with the other Principal Members selected for award. Further, award may be made to other than the offeror who offers the lowest cost proposal.